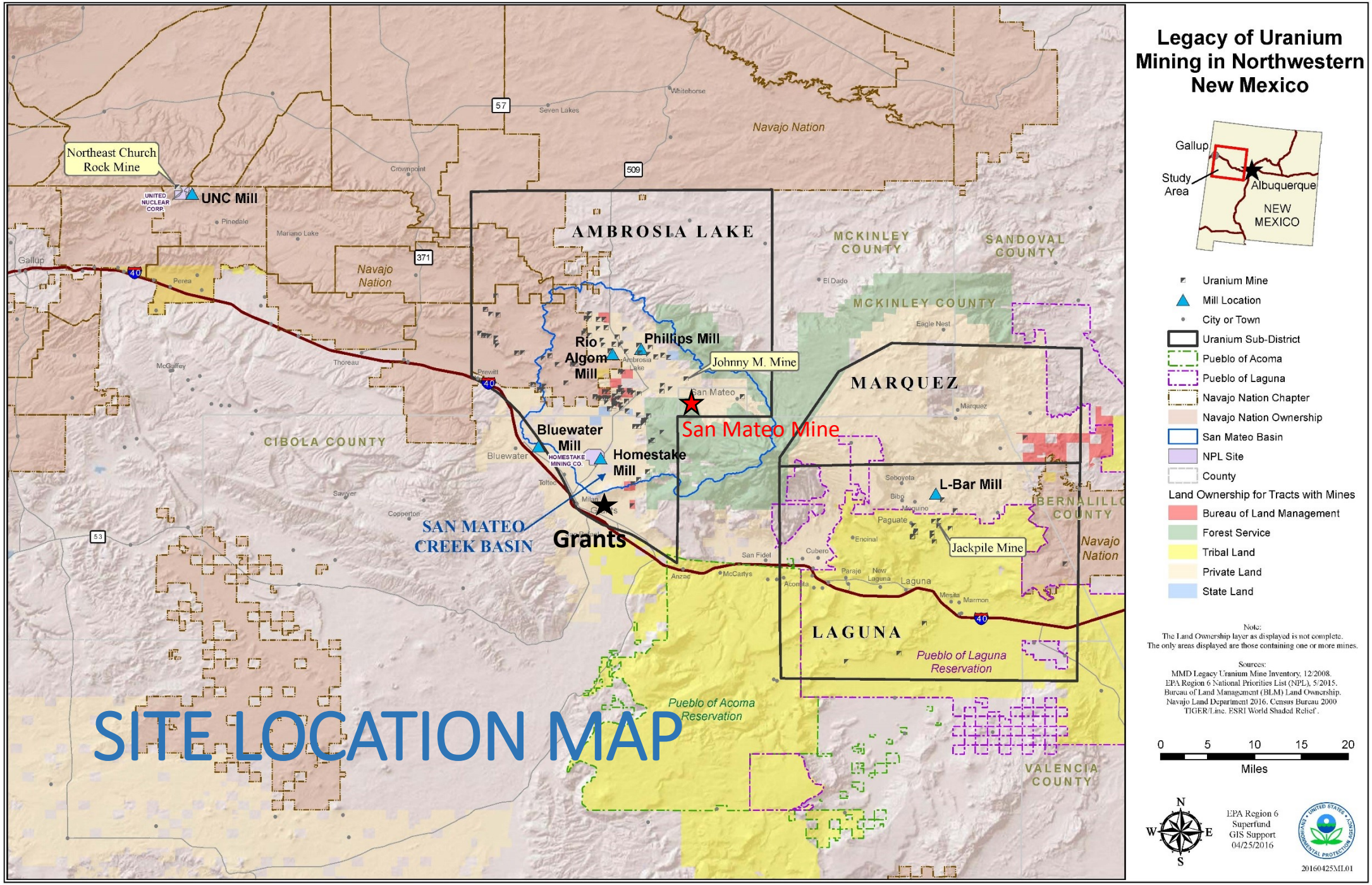
EPA GROUND WATER INVESTIGATION

San Mateo Creek Basin Uranium Legacy Site

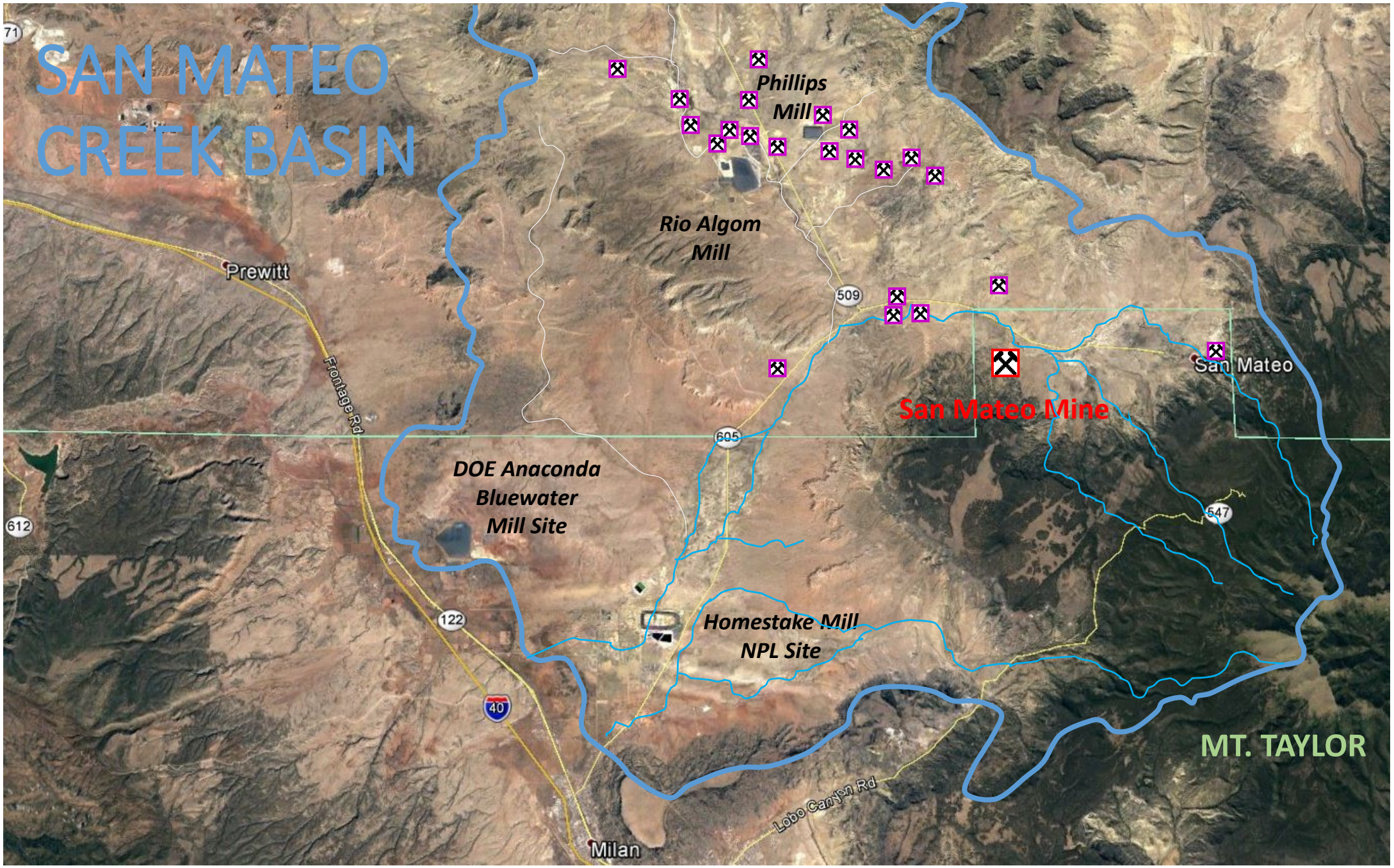
January 12, 2017

9881583

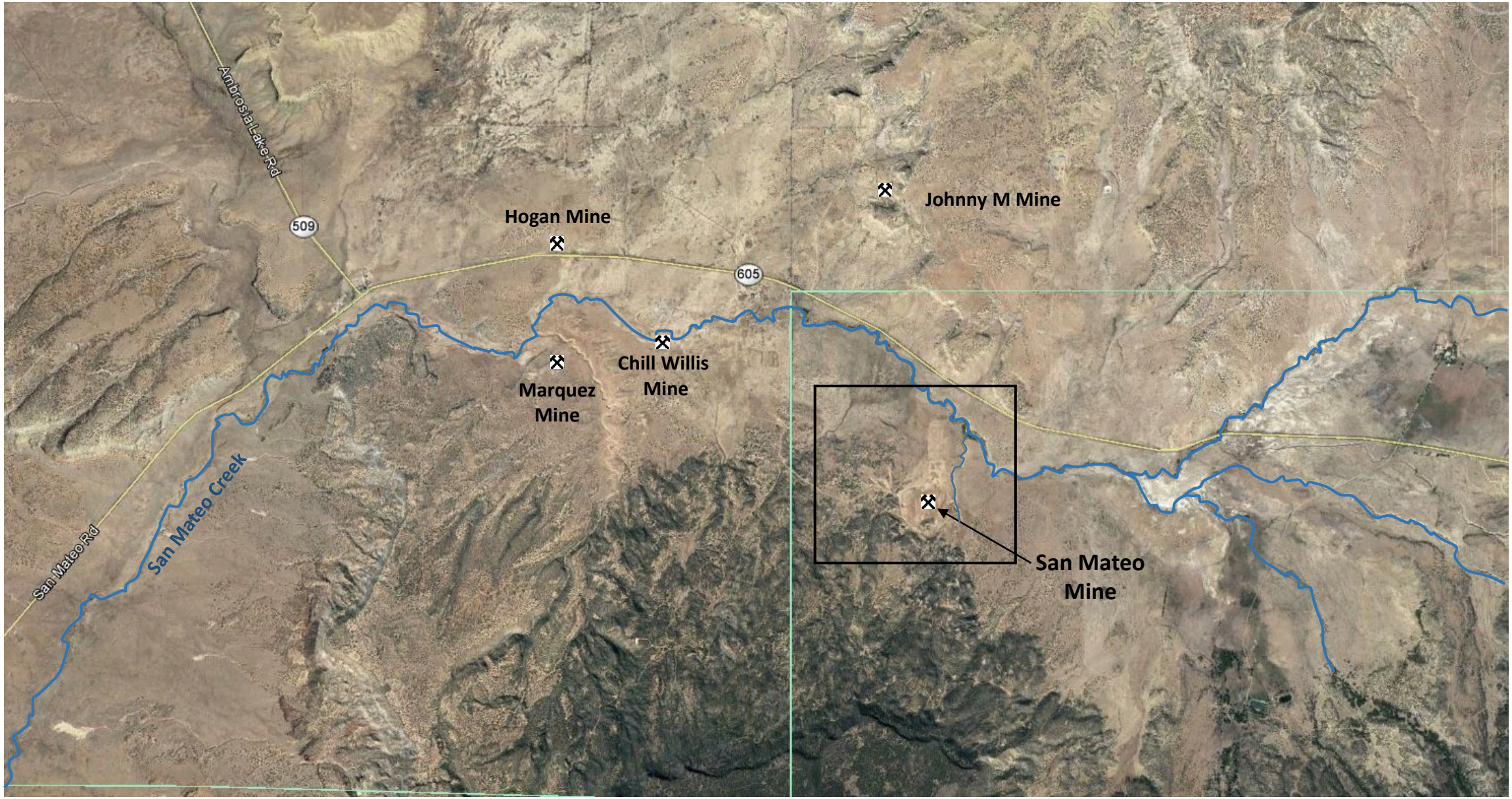


SITE LOCATION MAP


San Mateo Creek Basin
321 Square Miles
San Mateo Mine
Milan
Grants
Paguate
Encinal
Seama
Laguna
Rio San Jose Basin
371
53
40
© 2016 Google


SAN MATEO CREEK BASIN
Phillips Mill
Rio Algom Mill
Prewitt
509
San Mateo
San Mateo Mine
Frontage Rd
605
DOE Anaconda Bluewater Mill Site
612
547
122
Homestake Mill NPL Site
40
MT. TAYLOR
Lobo Canyon Rd
Milan

UPPER SAN MATEO CREEK BASIN

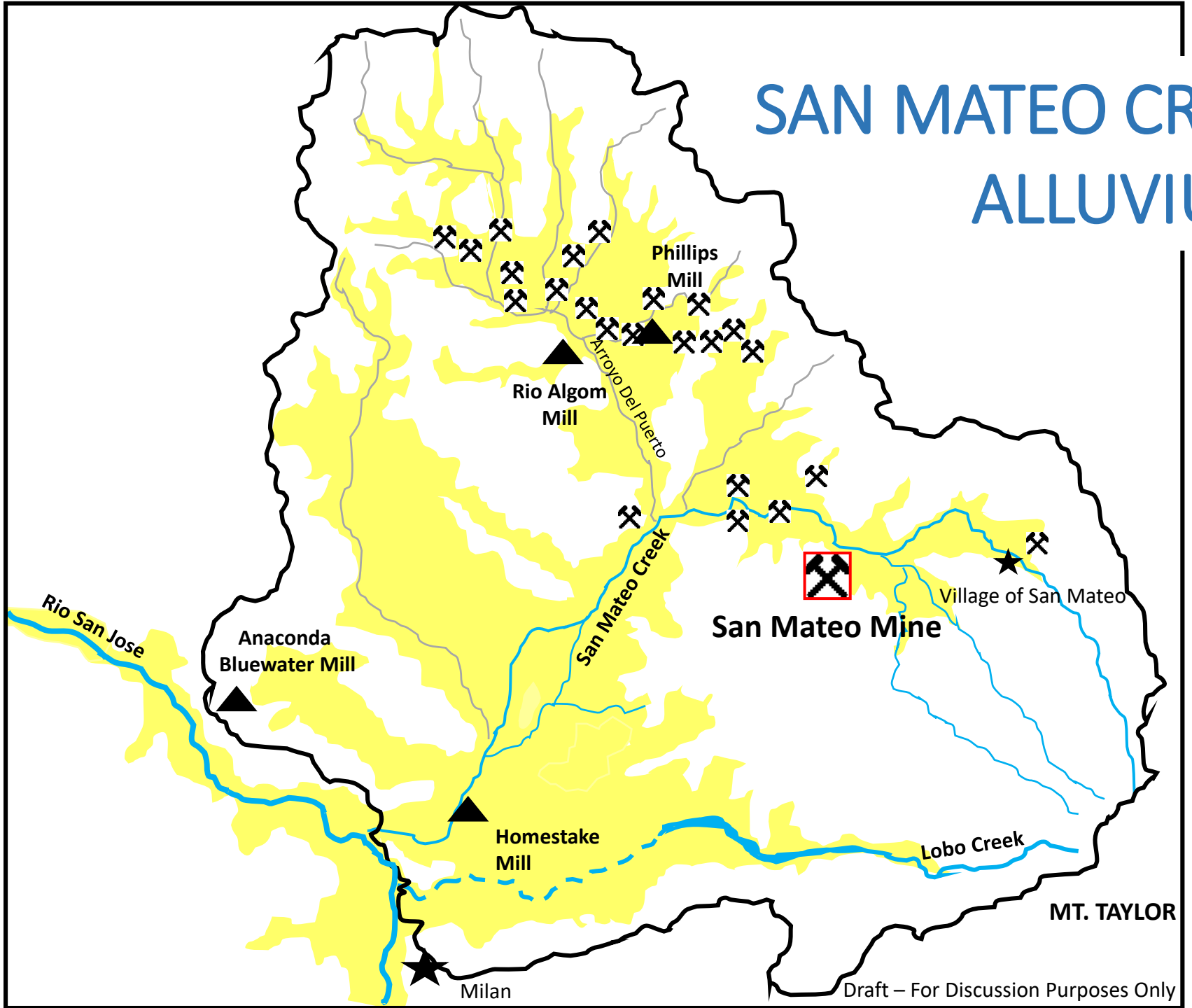


SAN MATEO MINE

ARROYO

Photo from USFS

SAN MATEO CREEK BASIN ALLUVIUM



Alluvium

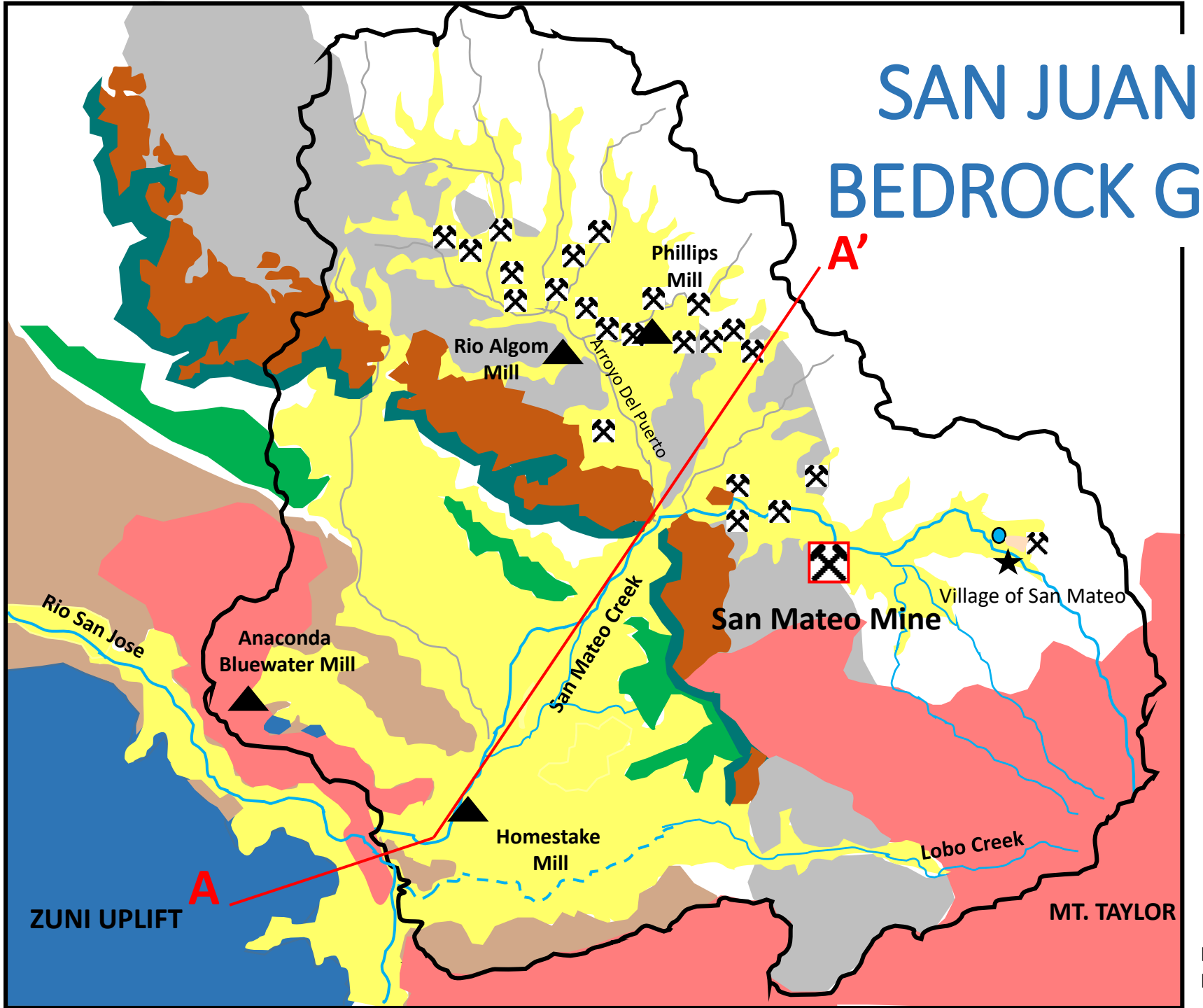
Wet Mine

ALLUVIUM:

Sediments Deposited in Basin from Erosional Processes;

Comprised of Sand, Silt, Clay and Gravel

SAN JUAN BASIN BEDROCK GEOLOGY



- Alluvium
- Mancos Shale
- Dakota Sandstone
- Morrison Fm
- Todilto Limestone
- Chinle Shale and Sandstone
- San Andres/Glorietta Limestone
- Volcanic
- Former Uranium Mill
- Wet Mine
- San Mateo Mine

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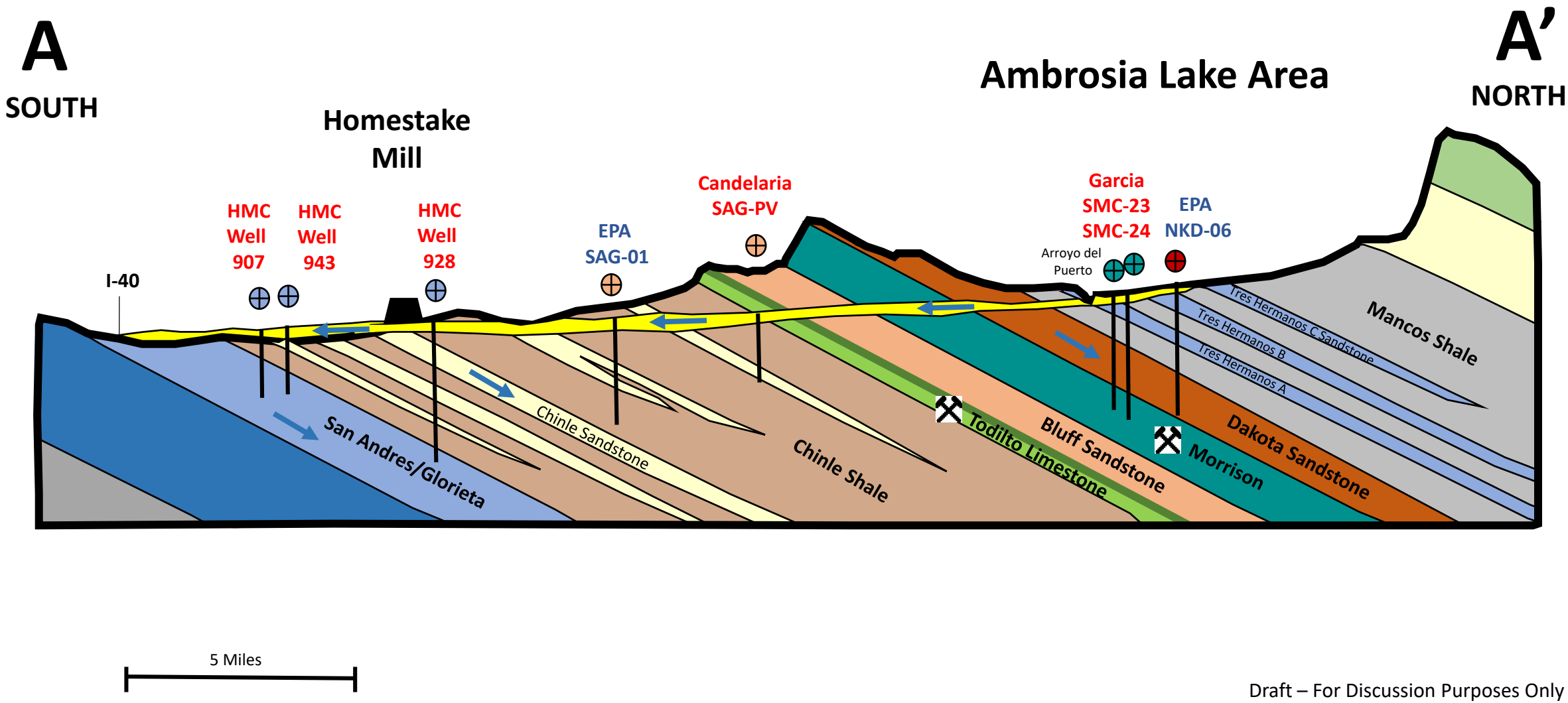
Based on USGS Geologic Map

CONCEPTUAL SITE GROUND WATER MODEL

Generalized Cross Section Through San Mateo Creek Basin



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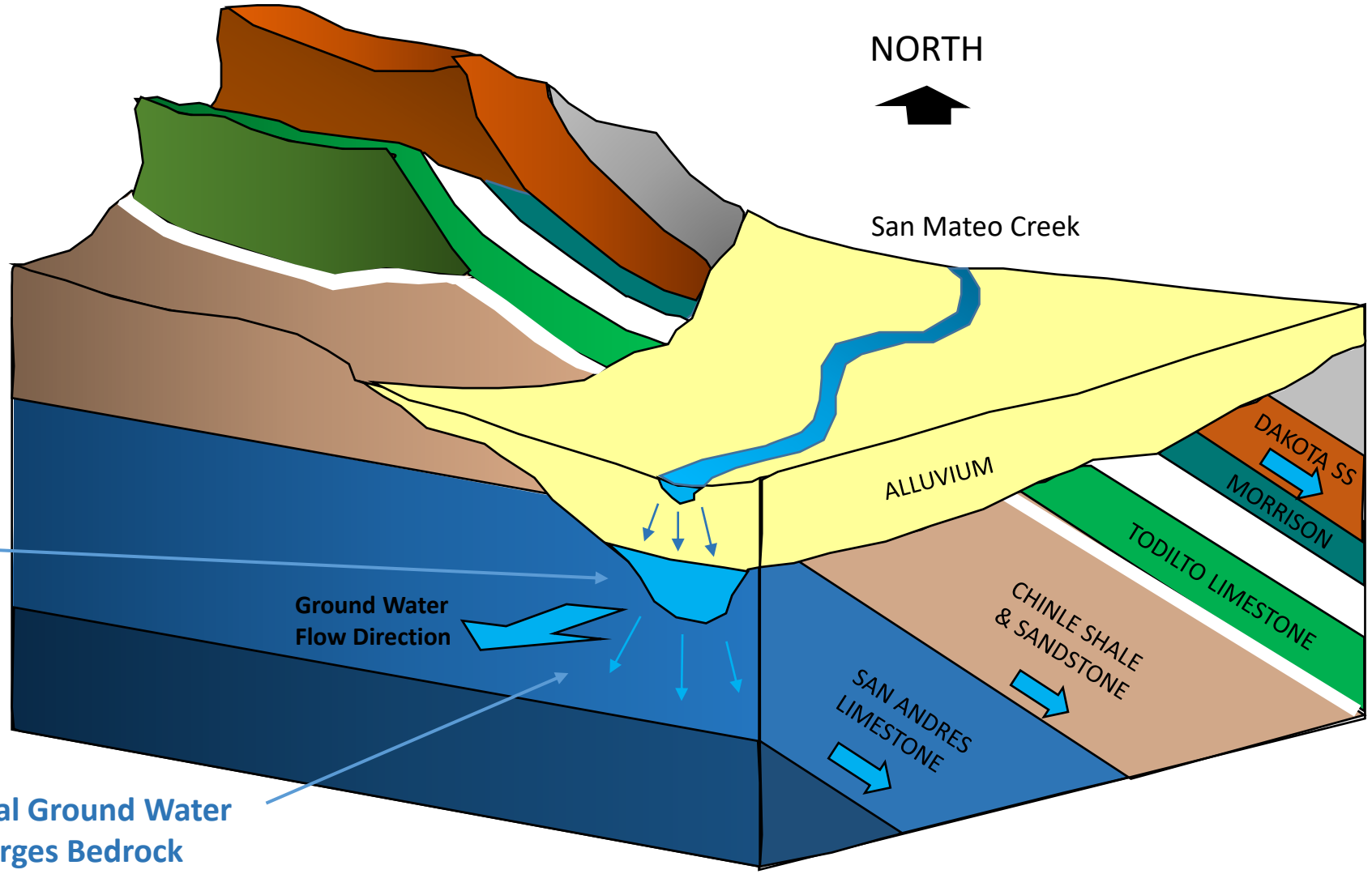
CONCEPTUAL SITE GROUND WATER MODEL



MULTI-PHASED GROUND WATER INVESTIGATION

Phase 1

Alluvial Aquifer
2012 – 2016

Phase 2

Bedrock & Alluvial Aquifers
2015 – 2017

Phase 3

Develop Conceptual Site Model
2016 - 2018

PHASE 1 COMPLETED

EPA Phase 1 Ground Water Report

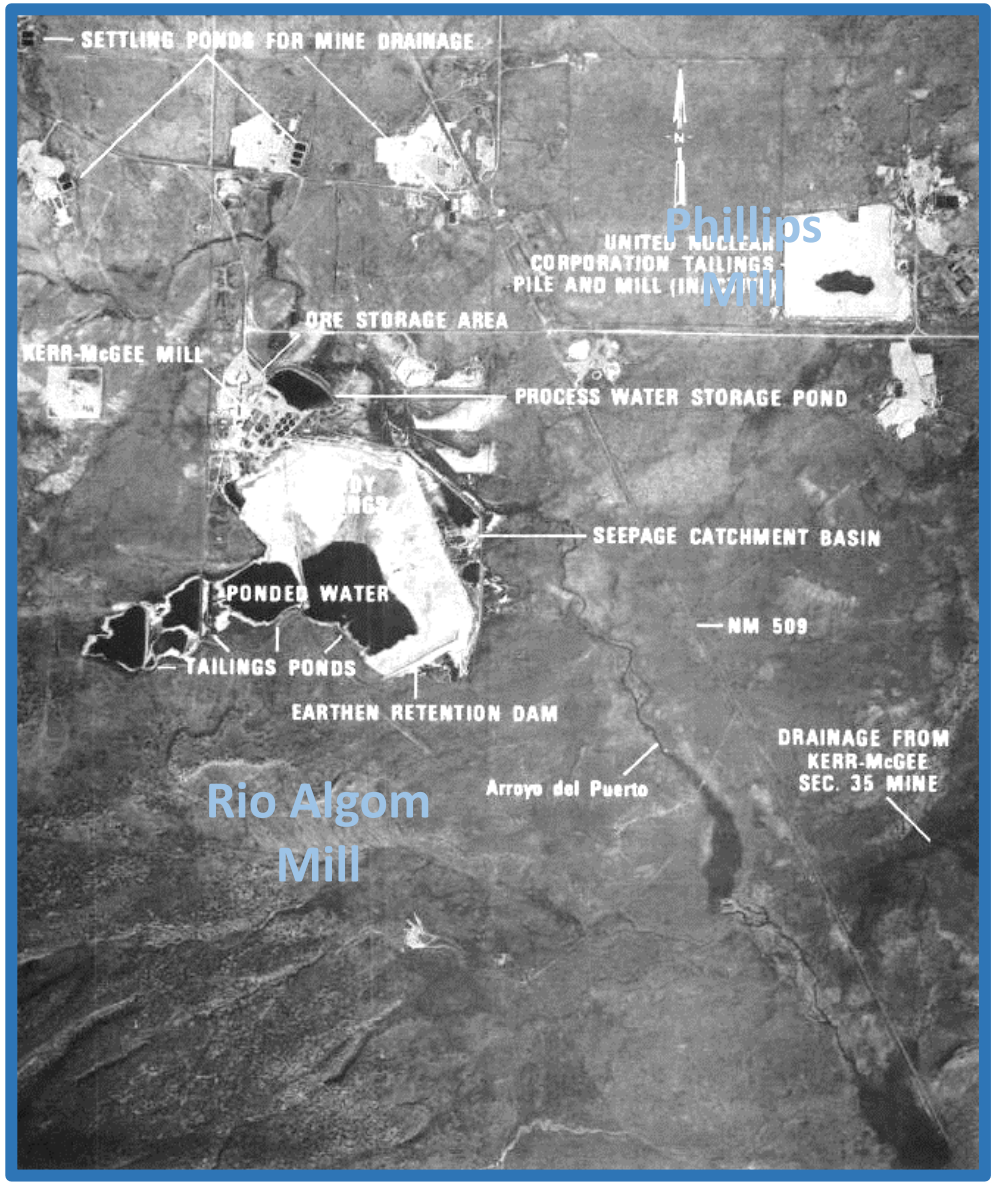
- Completed in August 2016
- Released to stakeholders in September 2016

Key components include:

- Summary of historical studies on uranium mining impacts
- Field investigation
- Findings and Conclusions

HISTORICAL STUDIES ON URANIUM MINING IMPACTS

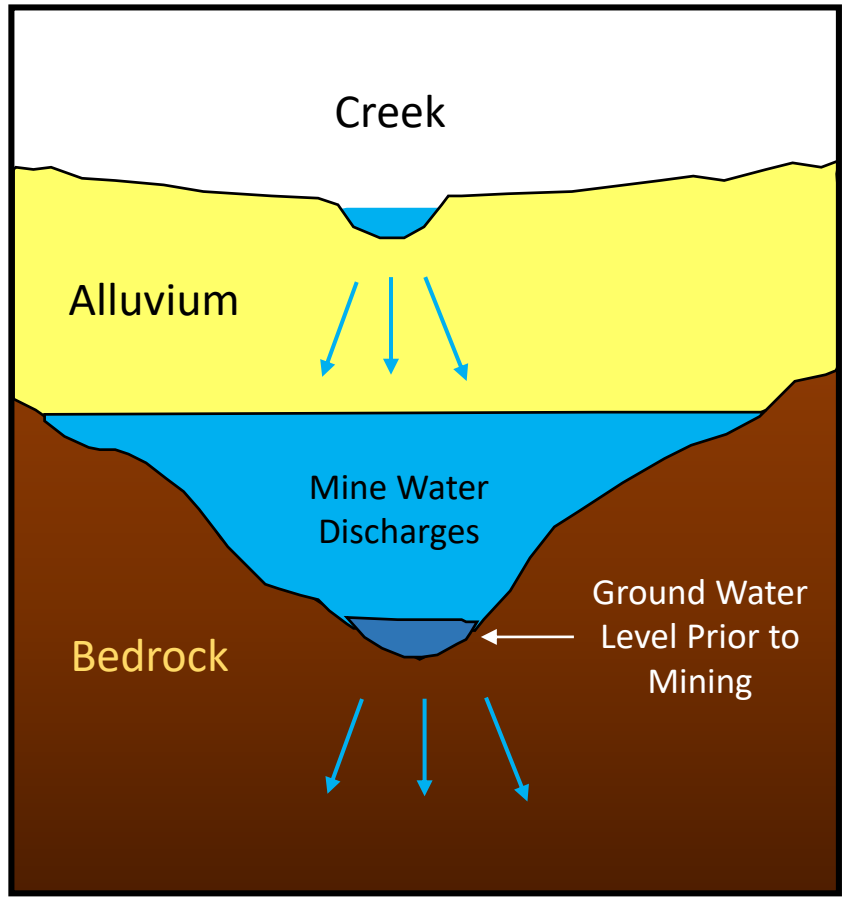
- 1975 EPA study
  - Ground water contamination discovered
  - Sources – mine water discharge and tailing seepage
  - Perennial flows created in creeks/arroyos
- 1981 and 1986 New Mexico studies
  - Alluvial ground water exceeds standards
  - Mine water discharge rapidly infiltrates and saturates alluvium



1975 – Ambrosia Lake Area

IMPACT OF MINE WATER DISCHARGE OPERATIONS

- ***Dewatered underground workings***
- ***Discharged billions of gallons*** of mine water to creeks and arroyos
- ***Water infiltrated*** into ground
- ***Increased amount of ground water*** in alluvial sediments and bedrock
- ***Changed quality*** of ground water



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Not to Scale

SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

Comparison to Alluvial Background Water Quality

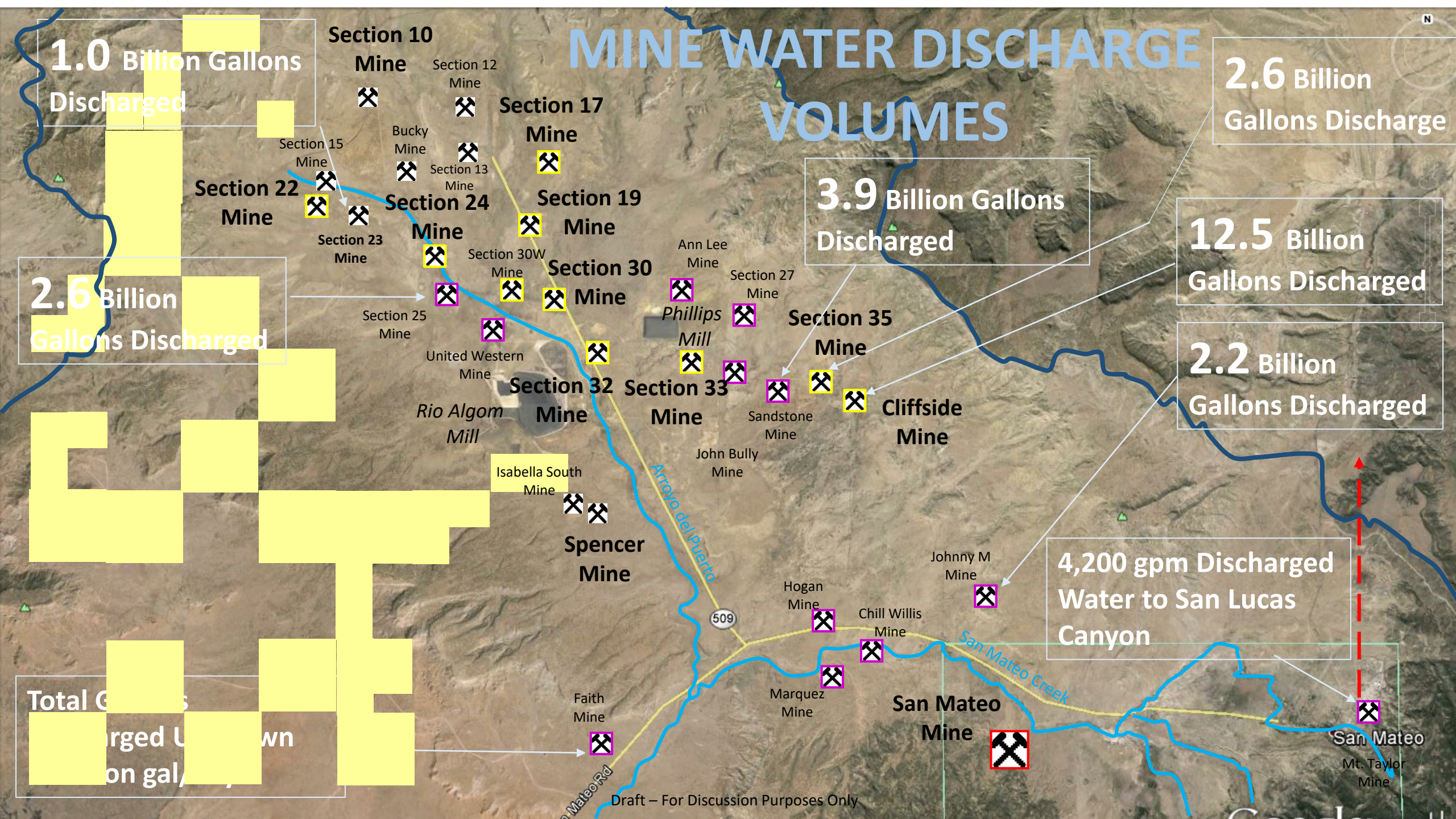
Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (mg/L)	1,690	520	125 – 300

New Mexico 1981 and 1986 Reports

MINE WATER DISCHARGE

Artificially Created Surface Flows in Creeks and Arroyos

⚒ Wet Mine


MINE WATER DISCHARGE VOLUMES
1.0 Billion Gallons Discharged
2.6 Billion Gallons Discharged
3.9 Billion Gallons Discharged
2.6 Billion Gallons Discharged
12.5 Billion Gallons Discharged
2.2 Billion Gallons Discharged
4,200 gpm Discharged Water to San Lucas Canyon
Total G s
rged U wn
on gal
Section 10 Mine
Section 12 Mine
Section 17 Mine
Section 15 Mine
Bucky Mine
Section 13 Mine
Section 22 Mine
Section 24 Mine
Section 19 Mine
Section 23 Mine
Section 30W Mine
Section 30 Mine
Ann Lee Mine
Section 27 Mine
Phillips Mill
Section 35 Mine
Section 25 Mine
United Western Mine
Section 32 Mine
Section 33 Mine
Sandstone Mine
Cliffside Mine
Rio Algom Mill
John Bully Mine
Isabella South Mine
Arroyo del Puerto
Spencer Mine
Johnny M Mine
Hogan Mine
509
Chill Willis Mine
San Mateo Creek
Faith Mine
Marquez Mine
San Mateo Mine
San Mateo
Mt. Taylor Mine
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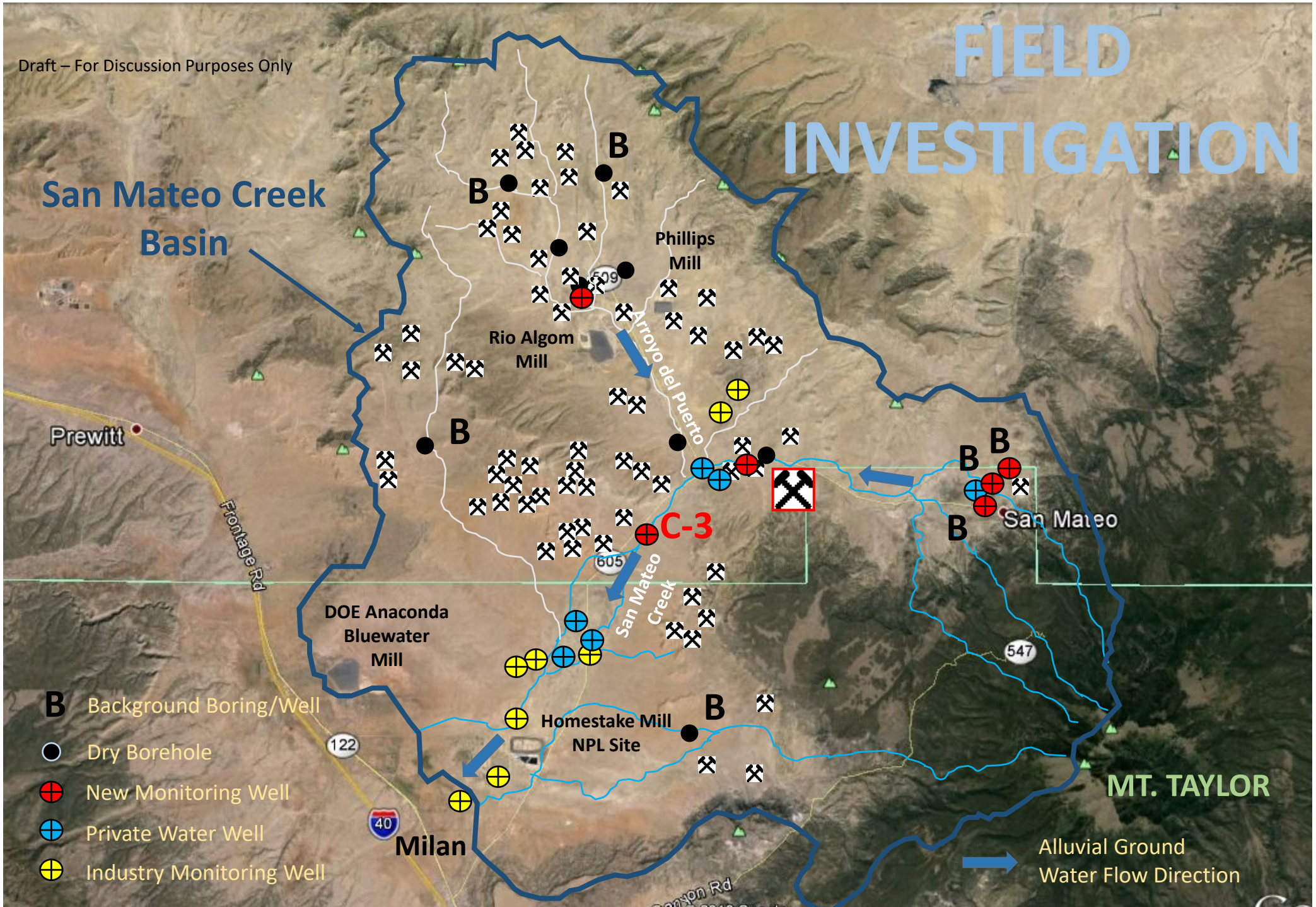
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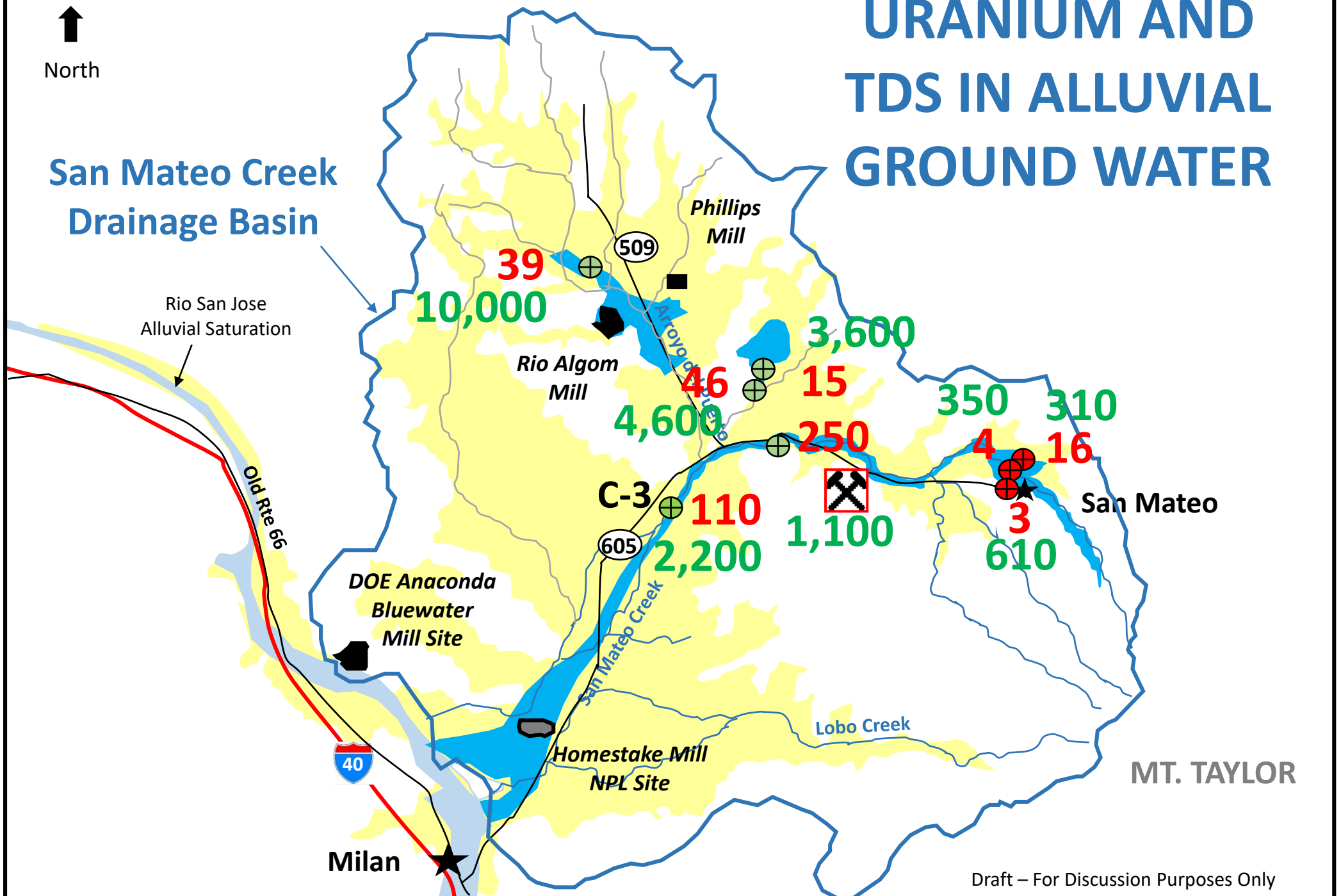
FIELD INVESTIGATION
San Mateo Creek Basin
Phillips Mill
Rio Algom Mill
Arroyo del Puerto
Prewitt
Frontage Rd
C-3
San Mateo
San Mateo Creek
DOE Anaconda Bluewater Mill
Homestake Mill NPL Site
Milan
MT. TAYLOR
B Background Boring/Well
Dry Borehole
New Monitoring Well
Private Water Well
Industry Monitoring Well
Alluvial Ground Water Flow Direction

SUMMARY OF CONCLUSIONS

Phase 1 Report

- Attempt to Characterize Alluvial Background had Mixed Results
  - Lack of Natural Saturation in Many Areas Investigated
- Alluvial Water Quality Varies Across Basin
  - Good quality upgradient of mines and mills
    - ✓ Meets standards
  - Poor quality downgradient of mines and mills
    - ✓ Exceeds standards
    - ✓ Similar to mine discharge water quality in some areas
- Mine Discharge Water Draining Through and Out of Alluvium


URANIUM AND TDS IN ALLUVIAL GROUND WATER
North
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Old Rte 66
Phillips Mill
509
39
10,000
Rio Algom Mill
Arroyo Atuelo
46
4,600
3,600
15
250
350
4
310
16
3
610
C-3
110
2,200
605
1,100
San Mateo
DOE Anaconda Bluewater Mill Site
San Mateo Creek
Lobo Creek
Homestake Mill NPL Site
40
Milan
MT. TAYLOR
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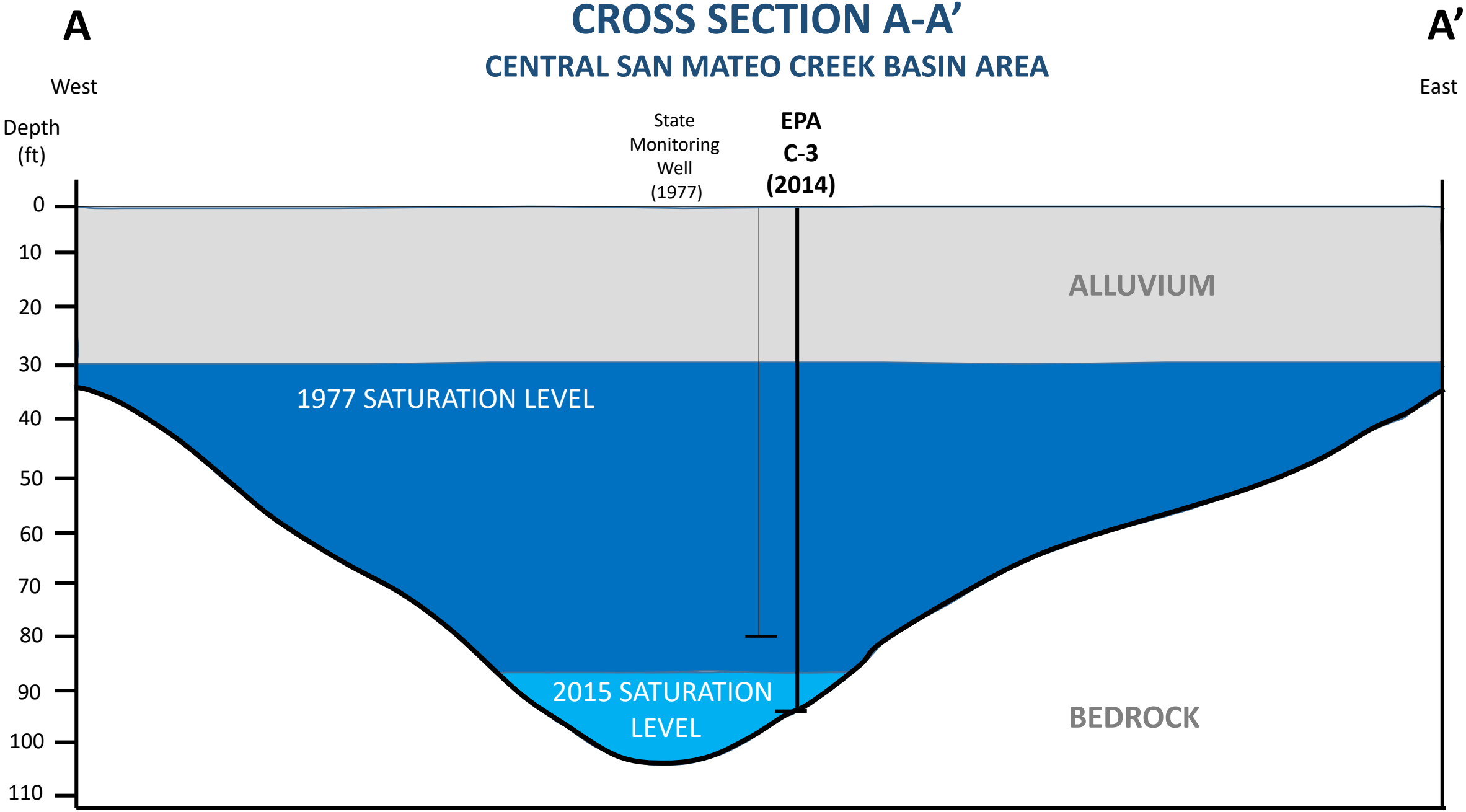
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
EPA Background Well
Well Downgradient to Legacy Mines
16 Uranium (ppb)
610 Total Dissolved Solids (ppm)

MASSIVE SATURATION AND DRAIN DOWN OF ALLUVIUM

- Caused by mine water discharges
- Water levels in central part of basin raised and dropped **OVER 50 FEET**
- Drain down not observed near Homestake

CROSS SECTION A-A'

CENTRAL SAN MATEO CREEK BASIN AREA



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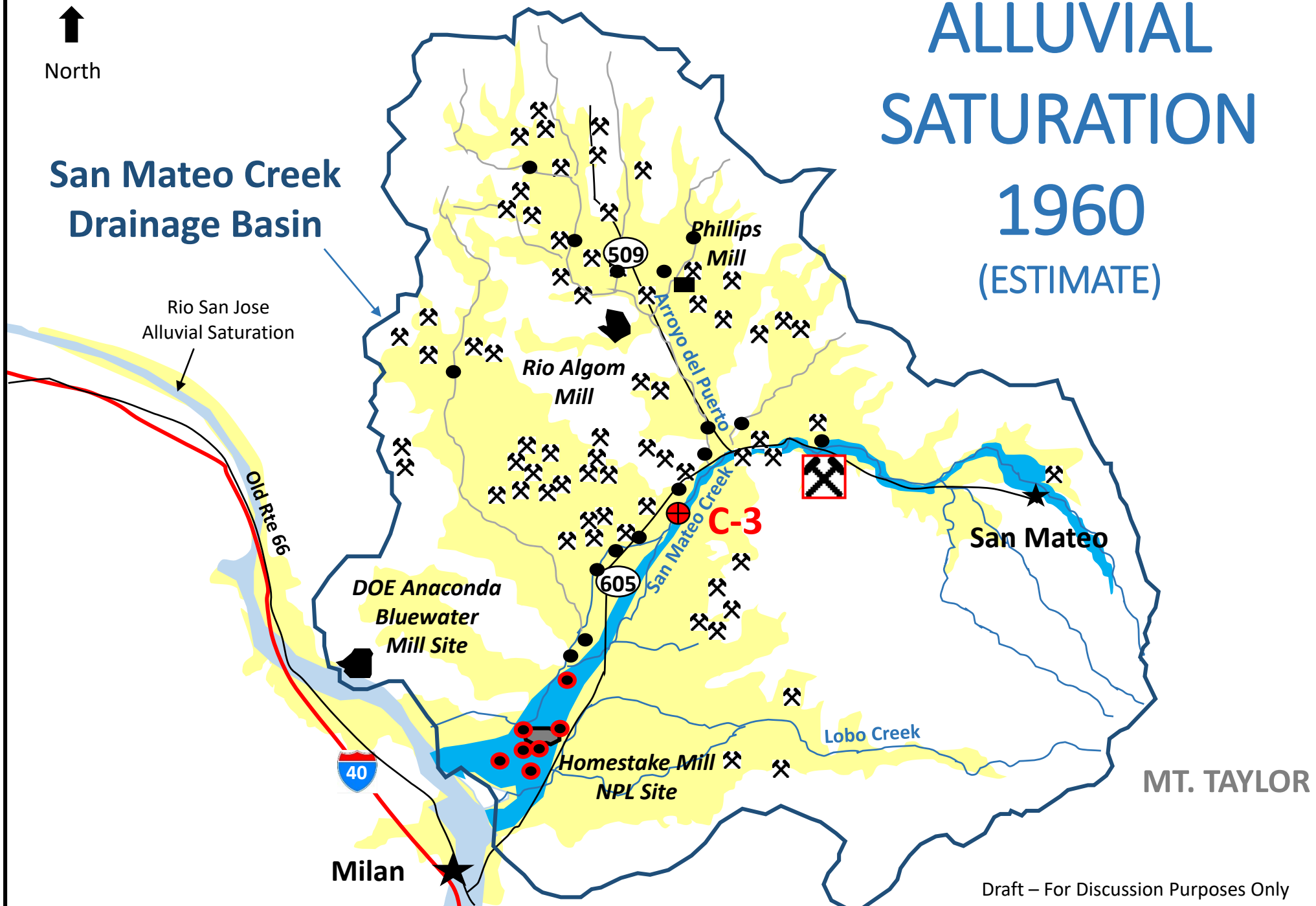
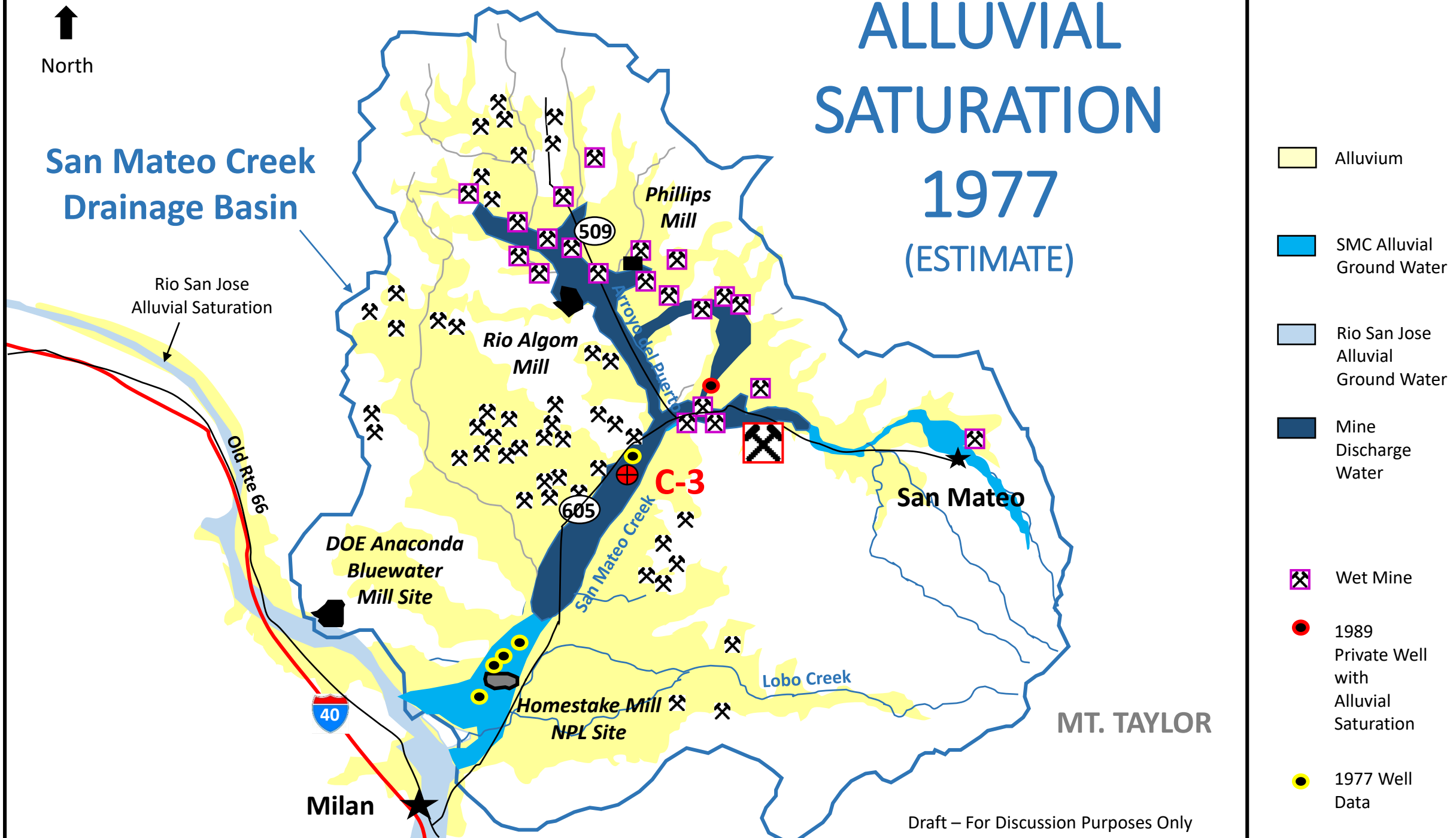

North
San Mateo Creek
Drainage Basin
ALLUVIAL
SATURATION
1960
(ESTIMATE)
Rio San Jose
Alluvial Saturation
Old Rte 66
509
Phillips
Mill
Arroyo del Puerto
Rio Algom
Mill
San Mateo Creek
C-3
605
San Mateo
DOE Anaconda
Bluewater
Mill Site
Lobo Creek
40
Homestake Mill
NPL Site
MT. TAYLOR
Milan
Alluvium
SMC Alluvial
Ground Water
Rio San Jose
Alluvial
Ground Water
EPA
Monitoring
Well - 2014
1960 or Older
Well
Dry Borehole
Drilled in
2014/2015
Draft – For Discussion Purposes Only


North
ALLUVIAL SATURATION 1977
(ESTIMATE)
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
Rio Algom Mill
Arroyo del Puerto
C-3
605
San Mateo
San Mateo Creek
DOE Anaconda Bluewater Mill Site
Old Rte 66
40
Lobo Creek
Homestake Mill NPL Site
Milan
MT. TAYLOR
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
Mine Discharge Water
Wet Mine
1989 Private Well with Alluvial Saturation
1977 Well Data
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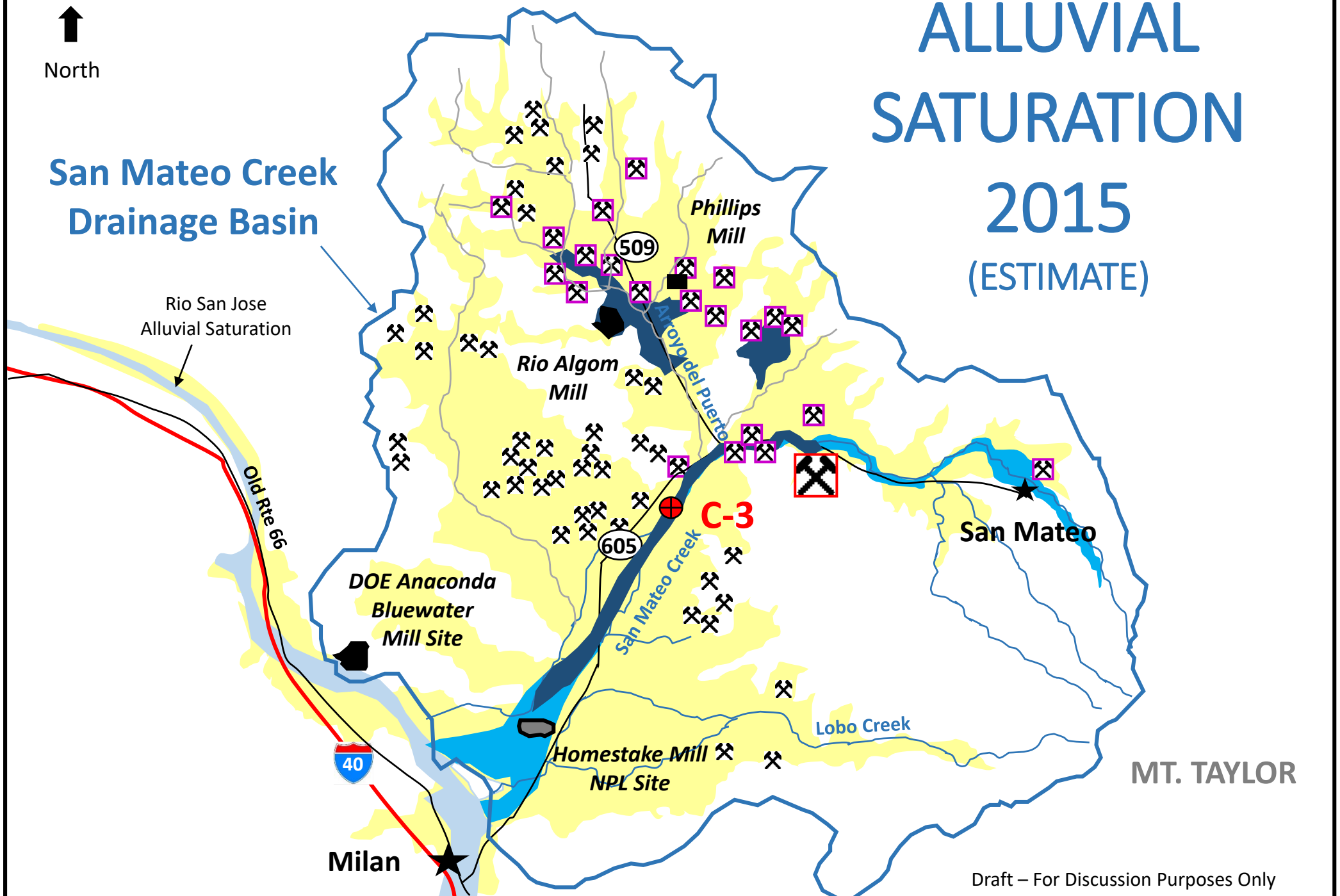
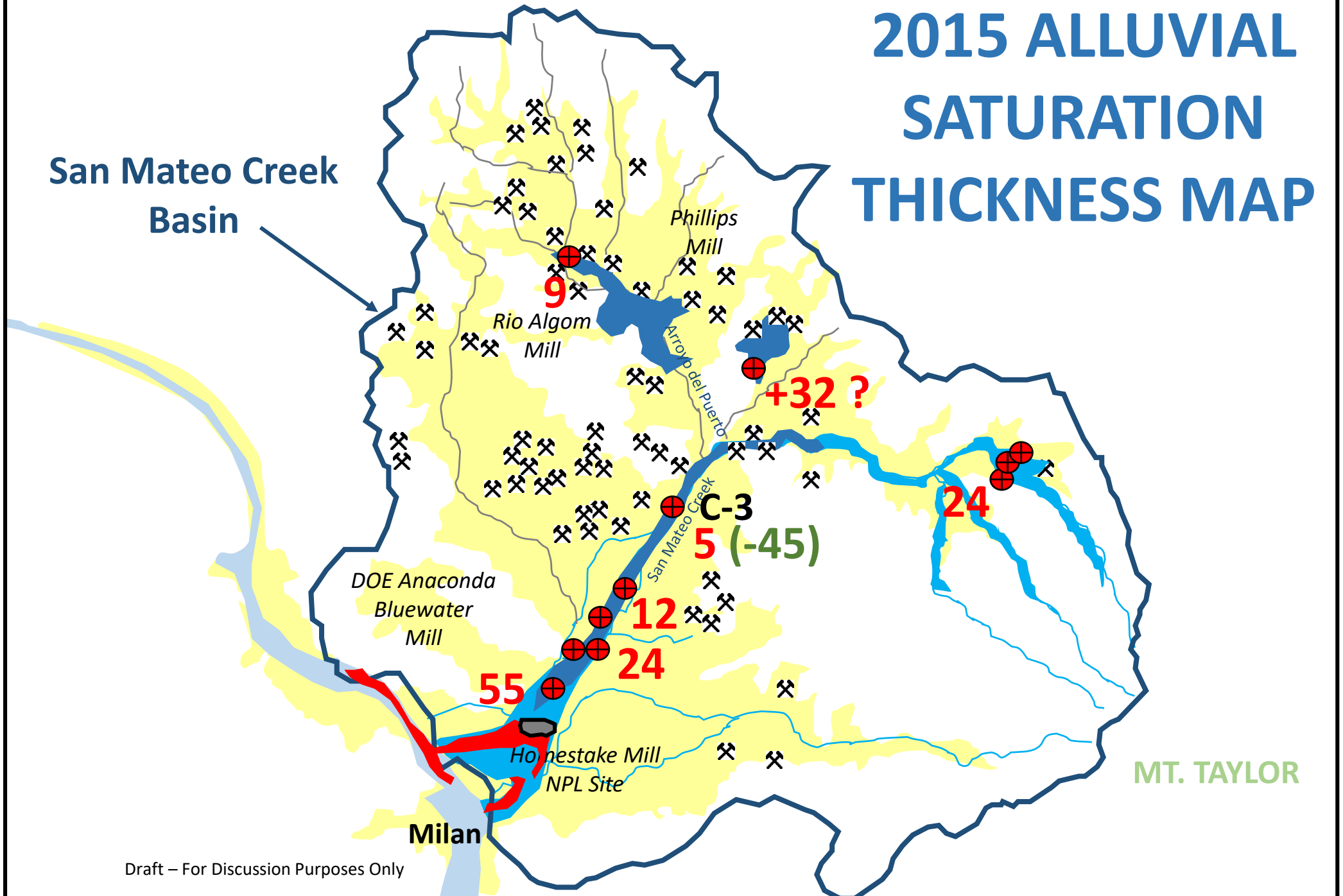

North
ALLUVIAL SATURATION 2015
(ESTIMATE)
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
Arroyo del Puerto
Rio Algom Mill
C-3
605
San Mateo Creek
San Mateo
DOE Anaconda Bluewater Mill Site
Old Rte 66
40
Homestake Mill NPL Site
Lobo Creek
Milan
MT. TAYLOR
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
Mine Discharge Water
Wet Mine
Draft – For Discussion Purposes Only

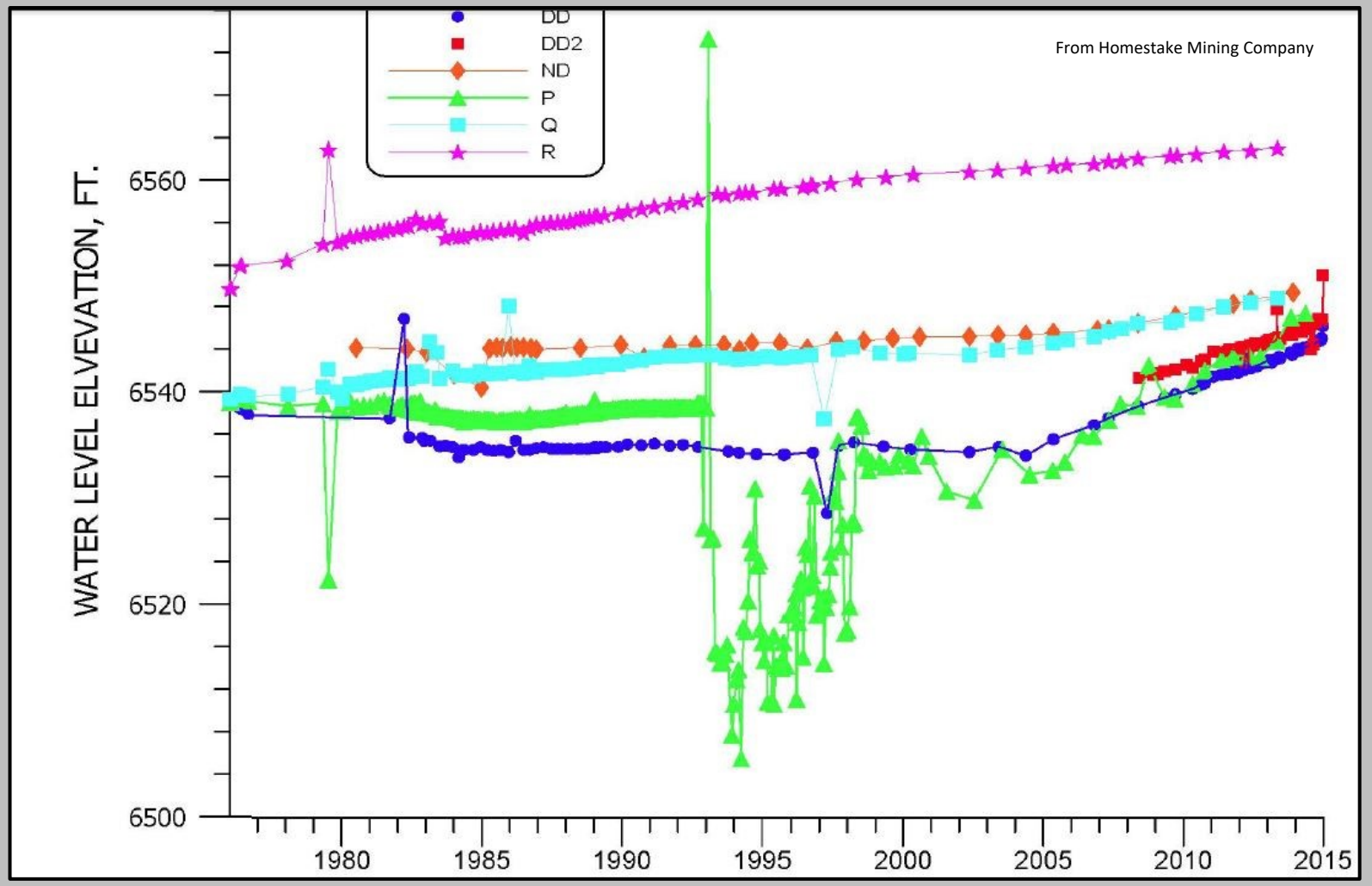
SUMMARY ALLUVIAL GROUND WATER QUALITY

- Alluvium
- SMC Alluvial Ground Water
- Rio San Jose Alluvial Ground Water
- Poor Alluvial Water Quality (Exceeds Standards)
- Poor Alluvial Water Quality Contaminated by Homestake NPL site and Bluewater DOE site (Exceeds Standards)


2015 ALLUVIAL SATURATION THICKNESS MAP
San Mateo Creek Basin
Phillips Mill
9
Rio Algom Mill
Arroyo del Puerto
+32 ?
C-3
5 (-45)
San Mateo Creek
24
DOE Anaconda Bluewater Mill
12
24
55
Homestake Mill NPL Site
Milan
MT. TAYLOR
Draft – For Discussion Purposes Only

HISTORIC WATER LEVELS

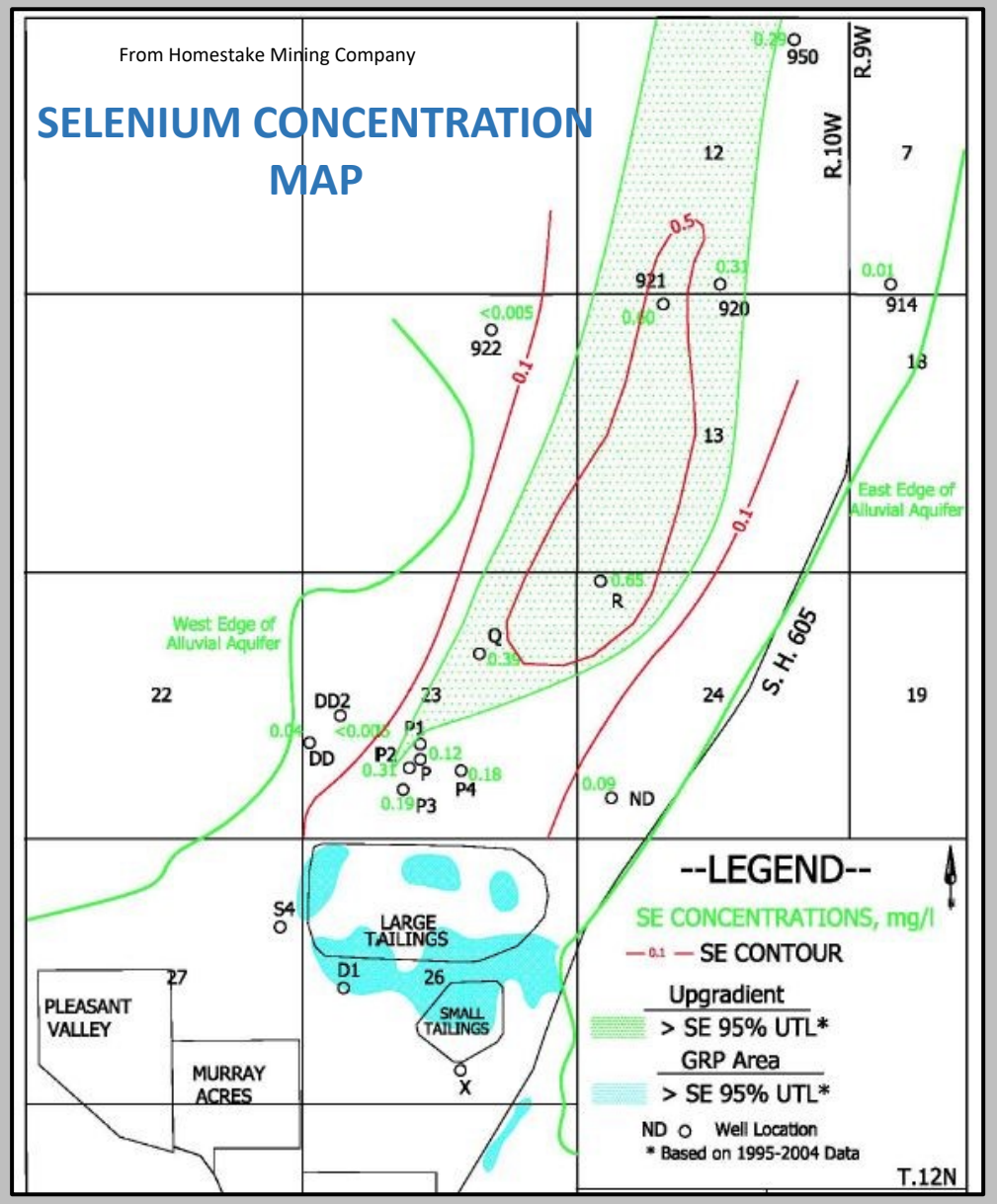
HOMESTAKE NPL SITE



HOMESTAKE NPL SITE

From Homestake Mining Company

SELENIUM CONCENTRATION MAP



From Homestake Mining Company

Selenium Concentration vs Time Plots

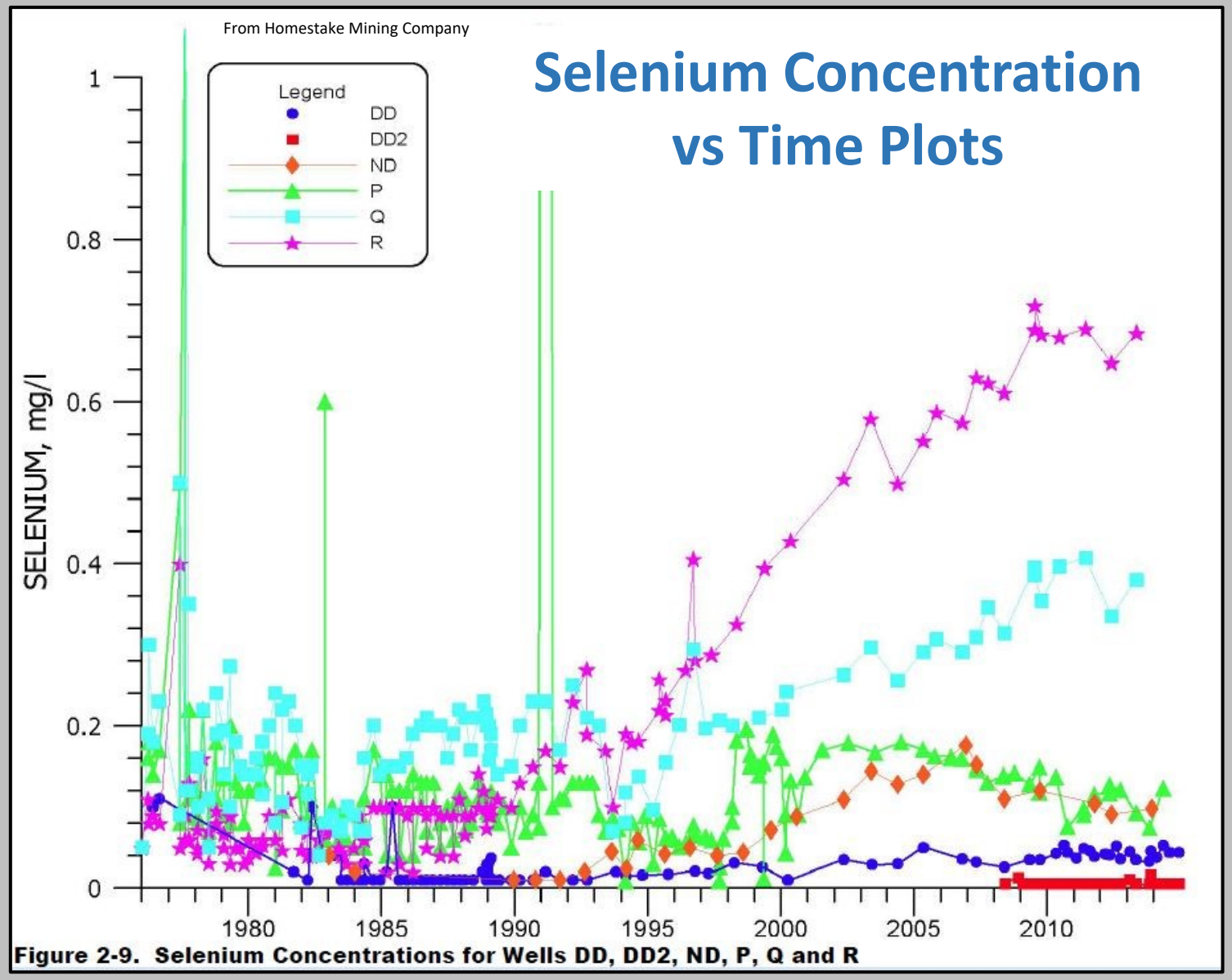


Figure 2-9. Selenium Concentrations for Wells DD, DD2, ND, P, Q and R

CONTAMINANT MASS LOADINGS FROM MINES

1		Section 35 Mine, Ambrosia Lake, NM								
2		Mass of Uranium, Molybdenum, & Selenium discharged from 1960 to 1976 before NPDES treatment required								
3										
4	**LOWER MINE WATER DISCHARGE RATE**									
5		**Discharge Period**	**Discharge Rate GPM**	**minutes per day**	**million gallons per day (MGD)**	**AVG COC concentration in mine effluent (MG/L)**	**Formula: lbs/day = dose X flow x 8.34 lb/gal**	**AVG POUNDS PER DAY (lbs/day)**	**AVG POUNDS PER YEAR**	**16 YEAR TOTAL POUNDS DISCHARGED**	***16 YEAR TOTAL TONS DISCHARGED***
6	URANIUM	1960-1976	850	1,440	1.22	5.25	(5.25 MG/L) X (1.22 MGD) X 8.34 lb/gal	**53.59**	**19561.39**	312982.19	***156.49***
7											
8	MOLYBDENUM	1960-1976	850	1,440	1.22	1.91	(1.91 MG/L) X (1.22 MGD) X 8.34 lb/gal	**19.50**	**7116.62**	113865.90	***56.93***
9											
10	SELENIUM	1960-1976	850	1,440	1.22	0.02	(0.02 MG/L) X (1.22 MGD) X 8.34 lb/gal	**0.20**	**74.52**	1192.31	***0.60***
11											
12											
13	**HIGHER MINE WATER DISCHARGE RATE**									
14		**Discharge Period**	**Discharge Rate GPM**	**minutes per day**	**million gallons per day (MGD)**	**AVG COC concentration in mine effluent (MG/L)**	**Formula: lbs/day = dose X flow x 8.34 lb/gal**	**AVG POUNDS PER DAY (lbs/day)**	**AVG POUNDS PER YEAR**	**16 YEAR TOTAL POUNDS DISCHARGED**	***16 YEAR TOTAL TONS DISCHARGED***
15	URANIUM	1960-1976	2,618	1,440	3.77	5.25	(5.25 MG/L) X (3.77 MGD) X 8.34 lb/gal	**165.07**	**60249.07**	963985.13	***481.99***
16											
17	MOLYBDENUM	1960-1976	2,618	1,440	3.77	1.91	(1.91 MG/L) X (3.77 MGD) X 8.34 lb/gal	**60.05**	**21919.19**	350706.97	***175.35***
18											
19	SELENIUM	1960-1976	2,618	1,440	3.77	0.02	(0.02 MG/L) X (3.77 MGD) X 8.34 lb/gal	**0.63**	**229.52**	3672.32	***1.84***